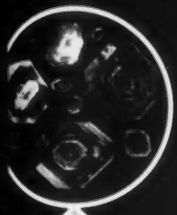
CHEMISTRY



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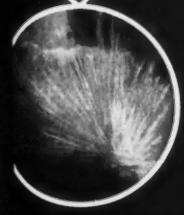

Unique ★ ★ ★
★ Chemistry ★
★ ★ ★ Hall

50¢

Chemistry and Medicine

➤ MEDICINE is both a science and an art. As a science, information is collected and organized for use in maintaining the human body in a state of health. This information must include a knowledge of all the parts of the human body and their functions. The fields of anatomy and physiology provide some of this information. Chemical techniques are utilized for obtaining much useful information for the physician.

The chemical analysis of urine provides information concerning the functioning of the kidneys as well as of the pancreas and liver. Since the urine is a waste product of the body, the information available is limited in its scope.

Since the blood, in essence, bathes all tissues of the body, its composition is very sensitive to changes in the functioning of all tissues and organs. A careful chemical analysis of the blood gives the most accurate picture of the physical health of an individual. In addition, some progress has been made in determining the mental health of an individual by the study of a blood chemical analysis.

The use of radioactive isotopes in medicine for diagnosis has become very important. Radioactive iodine is used as a standard method for determining the activity of the thyroid gland. A geiger counter held to the throat of a patient after he has drunk a radio-iodine cocktail provides the information needed in a matter of a few minutes.

Radioactive chromium is used in a standard method for measuring the total volume of blood in an individual without the necessity of removing all of the blood. Tumors may be detected and localized by the use of radioactive phosphorus and radioactive arsenic.

The spectrophotometer, the flame photometer, and the geiger counter have become standard equipment for the clinical laboratory. They provide the chemical information needed by the physician as he practices the art that is called medical treatment.

CHEMISTRY

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Including The Science Leaflet

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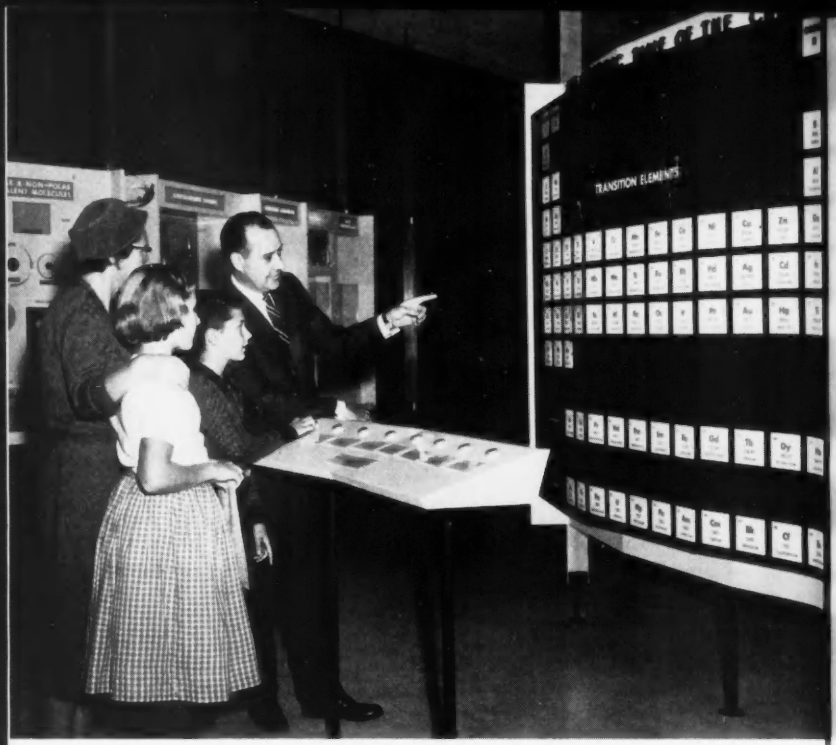
Unique Chemistry Hall

➤ THE SMELL of moth balls can be found in the new, unique Hall of Chemistry in the Franklin Institute Science Museum, Philadelphia.

The smell comes from a special "odor bar" designed for guessing games.

When you bend down to peer into one of the small openings, you get a strong whiff of a familiar odor. By looking into an adjacent peephole, you discover you are smelling "moth balls," (para - dichlorobenzene), or from another opening "oil of wintergreen," (methyl salicylate).

➤ IMBIBING *at the odor bar.*



➤ PUSHING *the buttons for the giant periodic table.*

What's the point of this and other exhibits found in the Institute's Hall of Chemistry? Robert W. Neathery, Director of the Science Museum, said the hall was built to show students and adults that chemistry is a fascinating subject.

One 13-year-old evidently got the message. As he came in for the second time, he turned to his teenaged companions and said, "Hey do you want to see something cool?"

The something-cool was a giant black and white periodic table in the middle of the air conditioned hall. It answers questions by flashing its lights. By pushing question-buttons the teenager could find out, among other things, which of the 102 elements are named for people who discovered them or what elements are found in the human body.

Lining the walls are other pushbutton exhibits that visitors can watch, feel, and even listen to through telephones. The displays discuss such awesome sounding subjects as polar and nonpolar covalent molecules and biochemistry. But with color, drama and imagination, these are brought

➤ FASCINATED *by the model of DNA molecule segment.*

down to earth and made interesting and even understandable. For example:

The growth of crystals — looking like minature fairyland forests — is shown in a rainbow of colors in five tall beakers revolving on a white disc.

The creativity of organic chemistry is shown in a gray and red display case with six-sided windows displaying a few of the products an organic chemist can create from benzene, a natural organic compound produced from coal gas, coal tar and petroleum.

And the DNA Molecule, one of the most complicated yet discovered, is shown in model segment. Looking like colored marbles strung by a child in no apparent design, the segment of the desoxyribonucleic acid molecule, vital for human life, stands about 4½ feet tall.

One of the most popular exhibits in the hall, however, is causing some commotion. The display shows what happens when water is separated into oxygen and hydrogen by an electrical current and a spark is added.

A mother and her young son were standing in front of the exhibit recently when the mother glanced away. Her son pushed the button to start the reaction. A minute later an "explosion" occurred. The mother in shocked dismay whirled around and said, "Johnny, what did you break?"

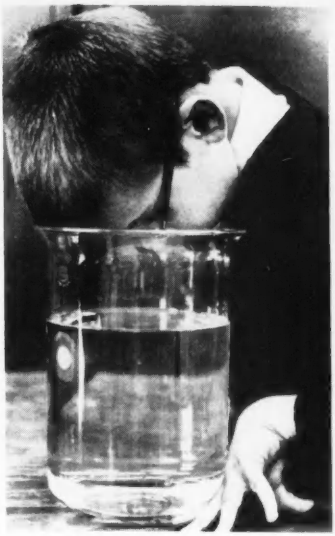
Johnny's curiosity and delight are seen mirrored in the faces of most of the students who push buttons, and listen to the recorded stories of chemistry, and watch a demonstrator in the hall's laboratory perform an interesting experiment such as the making of rubber.

For the Hall of Chemistry was designed by a high school science teacher, a college science instructor, and Institute officials to delight while instructing at an advanced level.

The Franklin Institute awarded "The President's Citation" to three Philadelphia-area men for their contributions to the establishment of the Hall of Chemistry in the Institute's Science Museum.

Recipients were: Dr. J. Bennett Hill of 402 Wynmere Rd., Wynnewood, Dr. William P. Ratchford of 221 Larimor Lane, Chesney Downs, Assistant Director, Eastern Utilization Research Laboratory, U. S. Dept. of Agriculture, and Dr. Charles Scott Venable of 10 Kershaw Rd., Wallingford.

The presentations were made by Institute President Wynn Laurence LePage at a dedication luncheon in Franklin Memorial Hall, Friday, Jan. 6. Dr. W. Albert Noyes, Jr., Professor of Chemistry at the University of Rochester and Editor of the American Chemical Society Journal, was the speaker for the 100 guests including chemists, industrialists and Institute officials. His topic was the role of chemistry and chemists in the future.



➤ WATCHING *crystals grow.*

At the presentation ceremony, Dr. Hill was cited for: "his untiring efforts and invaluable service as chairman of a committee to raise funds for the building of an outstanding educational exhibit in chemistry for the Science Museum.

Dr. Ratchford was recognized for: "his invaluable service as chairman of a committee which outlined the broad requirements necessary for an outstanding educational exhibit in chemistry for the science museum.

Dr. Venable was cited for: "his untiring efforts and invaluable service as vice-chairman of a committe to raise funds for the building of an outstanding educational exhibit in chemistry for the Science Museum.

Splat Cooling

➤ METALS and alloys having structures that never existed before, probably even in nature, are being created by a new process disclosed at the California Institute of Technology. The structures are expected to increase the range of properties and usability of metals.

The new metals are believed to be much stronger than conventional ones and some are suspected of having interesting electrical and magnetic properties.

"We have found a way to fool the atoms of metals into creating unusual crystal structures," said Dr. Pol Duwez, Caltech professor of mechanical engineering who developed the technique with the help of graduate students Ronald H. Willens and William Klement, Jr. The work is supported by the U. S. Atomic Energy Commission and the Office of Naval Research.

Although the process limits the production of abnormal alloys to small bits of thin foil, there are many applications of small quantities of materials in electronics and other fields.

The technique involves cooling molten droplets of alloys at the unprecedented rate of 2,000,000 degrees Fahrenheit per second. This is accomplished by blasting the hot droplets from a shock tube gun against the inside rim of a refrigerated metal wheel spinning at high speed. The procedure is informally known as "splat cooling" because the droplet is splattered against heat-absorbing copper on the wheel rim.

In their molten state, atoms of various metals mix well. Ultra-rapid cooling quick-freezes this mixture and doesn't give the atoms time to realign themselves into normal patterns as they do in the usual, slow cooling process. Also, a metal of much finer grain structure is produced. The individual grains are too small to be seen in an optical microscope. This should result in a marked increase in the strength of the foil.

"We had two purposes in developing this technique," Dr. Duwez explained. "One is purely scientific for the synthesis of new alloys to give us an insight into the theory of alloys. The other is to create alloys having interesting properties. As to their applications, they are still unknown.

Super Conductivity

"It is anticipated that the most interesting change in properties will be electrical and magnetic," he added. "The process may lead to the synthesis of new superconductive alloys."

Superconductivity is the ability of some metals at temperatures near absolute zero (459.6 degrees below zero Fahrenheit) to have a circulating electric current flow in them forever without energy loss. This property is expected to become useful in computers and other devices requiring very small amounts of energy to operate.

The unorthodox metals may have improved semiconductivity. They may lead to new types of transistor devices. Magnetic properties may be enhanced. Electrical resistance and corrosion resistance may be greatly modified.

So far, the investigators have created four abnormal alloys by "splat cooling." The first was copper and silver. In the normal alloy of this combination, the atoms of the two metals refuse to share individual crystals or grains. That is, the alloy consists of a grain of copper atoms joined to a grain of silver atoms, and so forth. "Splat cooling" forces the atoms of silver and of copper to reside happily together in a single grain and the grains are much smaller than normal.

This structure is detectable through standard x-ray diffraction techniques by which the different atomic lattice patterns of metals and alloys have been determined.

Stable Grains

Germanium and silver, which also normally alloy in different grains, have been "splat cooled" into single grains of alloy. The same also is true of gallium antimonide and germanium, both of which are semiconductors.

While the first three abnormal alloys remained stable after cooling, the fourth one, gold-silicon, proved to be unstable. X-ray diffraction examination immediately after "splat cooling" showed its atoms had been frozen in a random distribution like that of glass. Examination 24 hours later disclosed that after the alloy had cooled its atoms had rearranged themselves into an unknown complex pattern. It may have unusual properties.

Splat Cooler

Dr. Duwez' "splat cooler" consists of a small shock tube containing a crucible and heating unit at one end to melt the metal, and a wheel with an inner rim of copper. The alloy is prepared in the usual way and a small stick of it put into the crucible, where it is melted.

Gas pressure is built up in the shock tube to the point at which it bursts through a plastic diaphragm. The explosively released pressure wave blasts the molten droplet about one-quarter inch out of the shock tube's nose onto the copper inner rim. The droplet hits the copper with a velocity of nearly 300 miles an hour. The impact spreads it quickly into a very thin layer some 20,000 atoms thick and perhaps a half inch in area.

The foil is held firmly against the copper by a centrifugal force of 6,000 g's from the spinning wheel. The wheel is cooled to 314 degrees below zero Fahrenheit by being partly immersed in liquid nitrogen.

The fact that the foil is spread so thin by the heavy impact and held so tightly against the copper makes for a very effective contact between the foil and the heat-absorbing copper. Thus the heat is extracted much more rapidly than normal, preventing the foil's atoms from aligning themselves into their usual patterns and halting the growth of the normal metallic grains.

Thermoelectric Alloy

➤ One of the most efficient thermoelectric materials yet developed was discussed at the International Conference on Semiconductors at Prague, Czechoslovakia. The compound, first discovered by J. H. Wernick of Bell Laboratories, is composed of the elements silver, antimony, and tellurium. Its chemical designation is silver antimony telluride ($AgSbTe_2$).

Thermoelectric devices presently being considered by industry are based on a principle discovered over a century ago. This discovery showed that when two dissimilar metals were joined together in a circuit, a current could be produced by heating one junction, while the opposite end was maintained at a relatively lower temperature. The reverse of the effect was also found; if a current was passed through the pair, one junction became hotter and the other cooler, depending on the direction of current flow. The effects in metals are quite small, but with the accelerated study of semiconductors following the invention of the transistor, much more efficient materials were found.

Practical Devices

Extensive development work is now being carried out on practical devices such as heat-to-power converters and localized coolers, especially for miniature electronic devices. Although inadequate for many proposed applications, the materials most widely used in present-day thermoelectric devices are lead telluride and bismuth telluride. The search for improved materials centered on ternary intermetallic semiconductor compounds, many of which have a cubic crystal structure similiar to sodium chloride. The desired crystal formation is somewhat disordered and contains heavy atoms such as tellurium. Many compounds, and alloys of compounds, some with as many as seven elements, have been produced and studied. The best of these discovered to date has been silver antimony telluride. This material is now being widely studied in laboratories in this country and around the world.

Synthesis

Synthesis of these alloys by Dr. Wernick involves the direct fusion of stoichiometric quantities of the desired elements. Zone refining is then used to produce pure samples.

The material possesses a very low thermal conductivity, necessary in order to maintain a temperature differential between two ends of a device. Its thermoelectric figure of merit, "Z", has recently been measured by scientists at Radio Corporation of America, and is reported to be about $1.75 \times 10^{-3}/°C$ over a range of 200° to 500°C, which is the best yet observed for p-type thermoelements in this range.

In the studies reported today, silver antimony telluride was described as having a disordered cubic structure, exhibiting a thermal conductivity as low as 0.0064 watts/cm°C at room temperature, only one one-hundredth that of germanium. While the material is always thermoelectrically p-type, its Hall effect is p-type in some specimens, and n-type in others, even when taken from a single ingot.

➤ Drs. Raymond Wolfe *(left) and Jack H. Wernick, both of Bell Telephone Laboratories, check the mounting on a sample of silver antimony telluride before measuring its Hall coefficient. The sample was cut from a zone-refined crystal of the new thermoelectric material.*

Dr. R. Wolfe, Dr. J. H. Wernick, and S. E. Haszko, all of Bell Laboratories, ascribe this anomolous behavior to the presence of a small amount of a second phase consisting of silver telluride, which is swept to one end by zone refining. This n-type compound appears to dominate the room temperature Hall coefficient at concentrations as low as 10 to 20%, while the p-type silver antimony telluride dominates the thermoelectric properties. Further studies of these anomolies are in progress and are expected to advance considerably the knowledge of semiconductors in general.

Among the objectives of these investigations is the realization of the optimum properties of this potentially useful material. In particular, the metallurgical problems of producing single phase materials and controlling carrier concentration are of primary importance.

Power Generators

➤ Scientists of Westinghouse Electric Corporation have united two advanced forms of power generation to convert the heat of fission inside a nuclear reactor directly into electricity, it was announced.

John W. Simpson, vice president and general manager of the Westinghouse atomic power division, said that, for the first time, a thermionic and thermoelectric generator was built into a nuclear fuel assembly and inserted into a reactor to produce electricity.

"It represents a major step toward utilizing the still untapped energy present inside a reactor," he noted. The successful experiment was conducted by Peter J. McCoy and Joseph C. Danko and was guided by Dr. William E. Shoupp, technical director of the atomic power department.

Test Unit

The test unit produced less than one watt of power, but its operation, Mr. Simpson said, "opened the door to some exciting possibilities," including:

1. — Continued development work may result in high temperature thermionic-thermoelectric generators for such applications as satellite power supplies, where modest amounts of power must be produced from low weight, small size equipment.

2. — Nuclear powered generating stations of the future may have three operational stages — thermionic elements to convert the high temperatures in a reactor into electricity, thermoelectric elements to utilize the more moderate temperatures and conventional generating equipment for lower temperatures.

"This dual generator has been a goal throughout the industry for some time. This successful experiment adds another concept that can be considered in selecting power sources for special applications," Mr. Simpson said. "Each particular system will have to be evaluated for its own requirements in weight, efficiency, cost, external environment and temperature.

"This is why it is important to consider all feasible methods and, if necessary, to combine their unique characteristics into a single system that will do the best over-all job."

New Concept

This new concept will allow us to take advantage of the high temperatures generated in nuclear reactors. While some fuel elements themselves reach temperatures above 4000 degrees Fahrenheit in the fission process, nuclear scientists can get only about 600 degree temperatures out of the fuel elements and into the surrounding water where the heat can be put to work. The high temperature advantage is lost because of the temperature drop from the center of the fuel to the outside.

To capture this energy at its source, scientists built a fuel element with the thermionic generator in its center and a thermoelectric generator surrounding it. Both methods of converting heat directly to electricity operate on similar principles, but at widely divergent temperatures. A thermionic generator operates at incandescence — about 3500 degrees F. — but will not function efficiently at temperatures below 2700 degrees F. A thermoelec-

tric unit, on the other hand, does not operate at such elevated temperatures, but works well in the temperature range of 600 to 1300 degrees F.

"By putting the two types of generators in tandem, the heat passing through the thermionic generator flows through the thermoelectric unit," Mr. Simpson explained. "The elements are wired in series to give a combined electrical output over a very wide temperature range."

Now that this experiment has established the feasibility of the fuel conversion system, he said, the development program will continue toward the goal of increasing the efficiency of the device.

Ancient Silver Cup

➤ THE RESTORATION of a corrosion-encrusted silver cup made with pride by some unknown silversmith over 3,000 years ago raised a problem which is puzzling scientists. The cup was buried in the ground of Enkomi in the island of Cyprus, where it lay hidden until modern times.

The problem concerns the decoration on the cup. As a result of laboratory work, the decoration was first reported to be an inlay of a substance called niello. Niello is a mixture of the sulfides of silver and copper and is the basis of jewelry which has been made for many hundreds of years by a very tricky process handed down from father to son in Siam (Thailand) and other parts of southeast Asia.

The Enkomi cup is dated at 1,400 B. C. If the niello decoration was used in Cyprus at that early date, it is a discovery of great importance to archaeologists.

But Drs. G. F. Claringbull and A. A. Moss of the department of mineralogy of the British Museum report they believe that the evidence suggesting the decoration might be niello is not conclusive. They consider the evidence is that the Enkomi cup was inlaid with copper.

When first excavated, the cup was covered with green corrosion products. Preliminary examination showed the presence of gold and a black powdery substance. When the black powder was analyzed spectrographically, the results indicated that it might be niello. The next problem was how to remove the corrosion results of some three thousand years in the ground without destroying either the gold or the niello. Laboratory experiments with niello showed that it would resist being soaked in hot formic acid. The hot acid was therefore used to wash off the incrustation. Beneath, "the original decoration was revealed in a surprisingly fresh condition."

Dr. Harold J. Plenderleith of the International Centre for the Study of the Preservation and Restoration of Cultural Property in Rome explains why he feels the Enkomi cup was decorated in niello. The perfection of line and luster survived immersion for 20 minutes in commercial formic acid at boiling temperature without any sign of loss. The black patterns were "lustrous or splendent and enamel-like" and, where undamaged by time and the soil, the material formed a perfect tracery of shiny jet-black mass-and-line ornament in the bright silver groundwork.

Scientists in Diplomacy

➤ Scientific and technical "ambassadors" throughout the world are speeding the interchange of information, advancing knowledge and opening new avenues for research and development.

The United States today has nine scientists serving as attaches in diplomatic missions in Europe, Asia and South America. They are aided by five deputies, also professional scientists. Besides proficiency in their respective scientific areas, such as physics, chemistry, oceanography, biophysics, chemical engineering, zoology, geophysics, each man can speak the language of the country to which he is assigned.

ICA

In addition to the science attaches under the Department of State, more than 3,000 American scientists, educators, engineers and other technical experts are working under the International Cooperation Administration in 60 countries in the Far East, Middle East, Europe, Africa, Asia and South America.

There also are the hundreds of similar specialists at key posts abroad attached to the military services, Government agencies such as the Department of Commerce, the Central Intelligence Agency and the United States Information Agency, the National Science Foundation, and a host of other quasi-official groups and foundations, all representing the United States. Operating under the State Department is a program for specialist training and exchanges. Significantly, one-quarter of the annual number of exchange visits with specialists of other countries are made by scientists.

Science Officers

International recognition of the importance of science in present-day diplomacy is underscored by the fact that more than a third of the foreign embassies in Washington have science officers.

The State Department's current science program and its attaches are an outgrowth of a number of studies made during and shortly after World War II in an attempt to apply to peace-time problems some of the lessons learned from the scientific efforts and achievements during the war.

In May, 1950, a report was issued by a special State Department Science Steering Committee under the chairmanship of Dr. Lloyd V. Berkner, physicist and at the time special assistant to the Department, recommending the creation of a science office. The position of science adviser was established; and Dr. Joseph B. Koepfli of the chemistry department at the California Institute of Technology was named to the new post.

Under Dr. Koepfli, well-known scientists were appointed for limited terms to serve as science attaches abroad. Despite a promising start, by 1954 the program had slowed down almost to a halt because of lack of funds for operation.

Dr. Brode

After Sputnik I, the office and pro-

gram for science in the Department of State was revitalized. In January, 1958, Dr. Wallace R. Brode, an outstanding chemist and then associate director of the Bureau of Standards, was appointed science adviser. When he resigned recently, he was replaced by Dr. Walter G. Whitman, head of the department of chemical engineering at the Massachusetts Institute of Technology.

The function of the Department's science attaches is advisory primarily on scientific developments as they may relate to foreign affairs. However, in addition, the science diplomats provide a close and effective liaison between this Government and the scientific communities of the countries to which they have been assigned.

Considerable time was spent in selecting the science attaches. Most of those who entered the service did so at considerable personal sacrifice, Dr. Brode told Science Service.

"They were motivated solely by the desire to make an important contribution to the national security and the advancement of science," he added.

Tenure

Two years has been the accepted tenure for a science attache who expects to return to an active career in science. This limitation is based in part on experience that indicates that generally the pursuit of a career in science and the pursuit of an active diplomatic career are mutually incompatible. After extended service, the active scientist tends to get lost in the diplomat. This, however, may prove to be advantageous in the instance of a career scientist who has retired and who, therefore, can fruitfully and without personal conflict serve as a science diplomat.

In such instances, or where the scientist may demonstrate unusually valuable service as a science diplomat, more permanent status in the Department may be desirable. Dr. Brode has said that his own experiences and observations in service in the Department have convinced him that a more permanent status and rating in the diplomatic corps should be made available for the science diplomats.

Career Diplomat

Dr. Brode told Science Service that the Science Adviser should have the status of a career diplomat so that in the administration of the program long-range objectives may be planned.

The tendency of the Administration has been to make advisory-type appointments for a limited period only.

However the future may deal with the role of science in U. S. foreign affairs, the advances made by the science attaches in the last two years have been impressive. In evaluating their achievements, Dr. Eugene G. Kovach, assistant to the office of Science Adviser during Dr. Brode's administration and now serving with Dr. Whitman, said, "These scientists in the Department of State have advanced successfully the causes of science as well as the objectives of our foreign policy. At this time in history, when science is intimately involved in all human affairs, the contributions that may be made by the science diplomats cannot be minimized."

United Nations

The United Nations, through its various organizations, is another

avenue through which American scientists are able to advance knowledge for the benefit of foreign researchers as well as benefit from knowledge gained through such international cooperation. The United States has supported substantially, both in funds and manpower, the World Health Organization, the United Nations Educational, Cultural and Scientific Organization, the Food and Agricultural Organization and other agencies. Both through the U. N., as well as through its own unilateral foreign policy, the United States has sent medical aid to countries throughout the world whenever such aid was needed. It also has sent trained personnel upon request to other countries.

East-West Cooperation

Science and technology also have been successfully in piercing the iron curtain of secrecy maintained by the Soviet Union. Despite the intensity of East-West political differences, the scientists from both sides of the iron curtain have cooperated to a significant degree at important international scientific meetings and have undertaken with success joint scientific research, notably in the Anarctic. Scientists, both East and West, are quite vocal in their respect, one for the other.

Policy Change

Recognizing this, the State Department this year (1961) has modified its policy restricting Government scientists from attending international meetings at which Communist China is represented.

Last May, the Department had refused to allow several members of the Public Health Service to attend a multilateral meeting in Moscow at which Communist Chinese scientists were scheduled to appear. The explanation was that it is not Government policy to accredit an official U. S. delegation to participate in conferences attended by nationals of unrecognized regimes.

Dr. Whitman

Dr. Whitman has said that though this remains our policy, it does not preclude Government employees from taking part in nongovernmental meetings at Government expense without accreditation "if the Department of State determines that their participation is in the national interest."

Without accreditation, a participant does not represent or speak for his government.

In line with this ruling, the Department of State has made known to the Department of Health, Education and Welfare that it has no objection to HEW's plans for participation of its scientists in the August, 1961 International Biochemistry Congress in Moscow which will be attended by Red Chinese scientists.

Perhaps as men from both political camps continue to advance together in conquering the vast frontiers of science, they may point the way to leaders of governments toward directing national energies to conquering new worlds of knowledge rather than each other.

Certainly the success of the many international scientific meetings has demonstrated that all men can work together to seek scientific truths.

√ *Chemistry Quiz* √

Directions: Mark the answer you think is *most nearly correct.*
Answers are on page 21.

A. Bioluminescence is principally the result of
1. a chemical reaction
2. an electrical discharge
3. cosmic radiation
4. reflection of light rays

B. Which of the following is caused by a metal and its salts?
1. actinomycosis
2. berylliosis
3. Busse-Buschka's disease
4. glucinium

C. To which series would the organic compound C_6H_6 belong?
1. anthracine
2. benzene
3. ethylene
4. methane

D. Nitrogen tetroxide has been discovered in the atmosphere of the planet Venus. This discovery is related to the
1. lack of free oxygen in the atmosphere of Venus
2. lack of plant life on Venus
3. pattern of radiowaves received from Venus
4. soil of Venus

E. The prefix "giga" is used to indicate a very large quantity. How many times x is "giga"?
1. 10^{12}
2. 10^{9}
3. 10^{6}
4. 10^{3}

Complete copies (with answers and norms) of many previous Science Talent Search examinations are available at 15c each from Science Service, 1719 N St., N.W., Washington 6, D. C.

Underground Hydrogen Bombs

➤ Low-cost energy may be provided by harnessing steam produced by underground explosion of hydrogen bombs, Glenn B. Warren, turbine designer and vice president of General Electric Company, said. Mr. Warren attributed this plan to Dr. Edward Teller, "father of the hydrogen bomb." The GE official said other suggestions for peaceful uses of underground nuclear bomb explosions made by Dr. Teller included: moving earth to make artificial harbors; underground chemical factories which would change the characteristics of minerals and other materials; creating underground reservoirs for flood waters; and open-pit strip-mining to depths of from 500 to 700 feet, possibly for oil shales or oil sands.

Beans, Tobacco, Roses Use Same Chemical

➤ APPLES, beans, tobacco and avocados may not smell like roses but they do use the same chemical, l-quinate, that goes into making roses smell good.

Dr. L. H. Weinstein, Dr. C. A. Porter and H. J. Laurencot, all of the Boyce Thompson Institute for Plant Research, Inc., in Yonkers, N. Y., reported to the American Institute of Biological Sciences meeting that they soaked leaves of these different plants in l-quinate tagged with radioactive carbon to see if it was used in producing aromatic substances.

As might be expected of different smelling plants, each type of leaf used the substance a little differently. Beans, they found, absorbed the smallest amount of the tracer substance but converted more than half to products that are a little closer to the ones responsible for fragrance. Tobacco, on the other hand, soaked up eight times as much of the chemical as beans but converted only about one-fourth of it.

Going a step further, the researchers found that in tobacco, apples, and avocados there was twice as much of one aromatic amino acid, phenylalanine, as of another, tyrosine. In beans, the opposite was true.

"Hidden" Spleen Seen

➤ THE SPLEEN now can be "seen" and studied by a new method developed at the University of North Carolina School of Medicine, reported to the American Roentgen Ray Society meeting in Atlantic City, N. J.

Commonly called a "hidden" organ, the spleen cannot be felt unless enlarged, and, until now, could not be studied adequately by other known methods, including diagnostic X-ray. The large, gland-like ductless organ in the upper left side of the abdomen performs important functions, including setting free the hemoglobin in blood that carries oxygen from the lungs to the tissues of the body.

Dr. Philip M. Johnson, until recently at the University of North Carolina School of Medicine, Dr. Ernest H. Wood, professor of radiology, and Dr. Stewart L. Mooring, assistant in radiology, found they could cause a radioactive substance, chromium-51 to concentrate rapidly in the spleen, permitting them a "scan" of the spleen both in normal persons and patients with diseased spleens. A scan is a picture of a body part made with electronic equipment sensitive to radioactivity. The researchers have used their method successfully and safely on more than 30 patients.

Their research was supported by a grant from the U. S. Public Health Service.

Analyzes Teachers' Personalities

➤ THE significant personality traits of teachers are probed in an eight-year study just published by the American Council on Education entitled "Characteristics of Teachers."

The author, David G. Ryans, collected information on the traits of 6,000 teachers in 1,700 elementary and secondary schools while professor of education at the University of California, Los Angeles.

In one of the major studies, Mr. Ryans, who now heads the department of educational psychology at the University of Texas, found that teachers who rated highly in their classroom performance, generally thought well of other people's behavior and motives.

They also showed strong interest in literature and the arts, participated in school and outside activities, and considered themselves ambitious and initiators.

By contrast, teachers rated low were on the average more critical of others, emphasized exactness and "practical things," and preferred activities which did not involve close personal contact.

Comparing the characteristics of women and men teachers in secondary schools, Mr. Ryans found that women tended to be more friendly, responsible, stimulating and democratic, while the men were more stable emotionally.

Single teachers, both men and women, rated higher in responsible, business-like classroom behavior and verbal intelligence than their married colleagues, but lower in emotional stability and stimulating teaching.

Mr. Ryans' study is the first comprehensive investigation of teacher behavior. But, he warns, the results apply mainly to groups of teachers rather than individuals and must be taken with a large dose of caution.

Condensation of Planets

➤ NEW EVIDENCE has been reported to support the theory that the earth and other planets were formed by condensation of material once a part of the sun.

Dr. Thomas Gold, head of the astronomy department at Cornell University in Ithaca, N. Y., said the high amounts of lithium on earth compared to the sun suggest that the solar system planets were previously part of a far-flung disk of the sun.

He believes that a careful search of the heavens might reveal a star and its surrounding material in a state corresponding to that before the sun's planets condensed.

Dr. Gold's theory is based on a recent observation by Dr. W. K. Bonsack of California Institute of Technology and Dr. J. L. Greenstein of Mt. Wilson and Palomar Observatories that certain stars whose brightness varies irregularly are abnormally rich in lithium.

They estimate there is at least ten times as much lithium per ounce of material on the surfaces of these stars as there is in the surrounding material.

Because of this high abundance of lithium, Drs. Bonsack and Greenstein suggest that these stars must be cap-

able of manufacturing this element, the lightest of all known metallic elements. One such manufacturing process could be through high-energy magnetohydrodynamic processes in the star's atmosphere, resulting from the release of energy residing in the original magnetic field.

Dr. Gold now proposes that the sun in its early stages would, as a result of shedding its magnetic energy, have formed an atmosphere rich in lithium as the T Tauri variable stars are observed to do. The planets then formed out of this solar material would have a high abundance of lithium.

Nickel in Cigarettes

➤ CIGARETTE smokers and manufacturers of cigarettes have a new worry about causing cancer.

The possibility of heavy smokers getting lung cancer from long-time inhalation of the trace amounts of nickel in cigarette tobacco was suggested in Chicago at a joint meeting of the American Society of Clinical Pathologists and the College of American Pathologists.

Drs. F. William Sunderman and F. William Sunderman Jr. of the Jefferson Medical College of Philadelphia reported experiments with rats, a species notably resistant to the induction of pulmonary cancer.

The rats were subjected to 30-minute inhalations of nickel carbonyl in concentrations of four parts per million three times a week for one year. Two or more years after the first exposure, cancerous tumors were observed.

Estimates of the amount of nickel that might be inhaled by heavy smokers of cigarettes, the researchers say, are similar to that proved cancer-producing in rats.

The hazards of exposure of industrial workers to nickel carbonyl or nickel dust have been studied previously by the Jefferson Medical College laboratory staff. It is well established that workers who have been chronically exposed to inhalations of the nickel compounds have a high percentage of respiratory cancer.

On the Back Cover

➤ THE BACK COVER *shows the thirty-two foot Glasteel polymerizer believed to be the tallest ever made, which was recently installed at a leading U. S. petroleum refinery for the production of polythylene resin. It was built to customer specification by The Pfaudler Co. of Rochester, New York, a division of Pfaudler Permutit Inc., prominent manufacturer of glassed-steel and alloy equipment for the process industries.*

The tower utilizes a two-piece Glasteel agitator approximately 24 feet in length. The two agitator sections are joined at the center by carbon steel flanges, which are protected from the highly corrosive process by a Hastelloy shroud sealed with Teflon packing. The agitator has no step bearing in spite of its unusual length. It directs the flow of the entering fill from the bottom upward and out the top of the vessel over a carefully controlled cycle time. The polymerizer is designed to operate at temperatures of 300° F. and pressures to 75 psi or full vacuum.

New Agent Preserves Blood

➤ THE PROBLEM of preserving whole blood for use when needed was considerably eased with the announcement that a recently developed preservative can keep enough red blood cells alive to permit safe and effective blood transfusions with blood 30 days old.

Dr. John G. Gibson II, associate in medicine at Peter Bent Brigham Hospital, Harvard Medical School, said clinical tests showed the preparation can be safely stored in routine hospital blood bank practice up to 30 days after collection. The preservative, Citrate-Phosphate-Dextrose, was developed at Harvard Medical School in 1956.

Dr. Gibson said the School's laboratories have now used the preservative to store blood from 27 to 32 days with an average red blood cell survival of 75%. The accepted safe minimum survival of red blood cells for transfusion is 70%.

Earlier this year Peter Bent Brigham Hospital used CPD-preserved blood in open heart surgery. No harmful reactions were recorded.

Dr. Gibson said the red blood cells' ability to remain in circulation and function normally after transfusion has been confirmed by tagging the cells with radioactive chromium.

Million-Dollar Atom Smasher

➤ A NEW million-dollar atom smasher for use in low energy nuclear physics research will be installed at the University of Pennsylvania under a National Science Foundation grant.

The 12-million electron volt tandem ion accelerator will be used to investigate the properties of the atom's nucleus. It also will enable the University to extend its research program in the study of irradiation damage of selective irradiation in the related areas of radiobiology and biophysics.

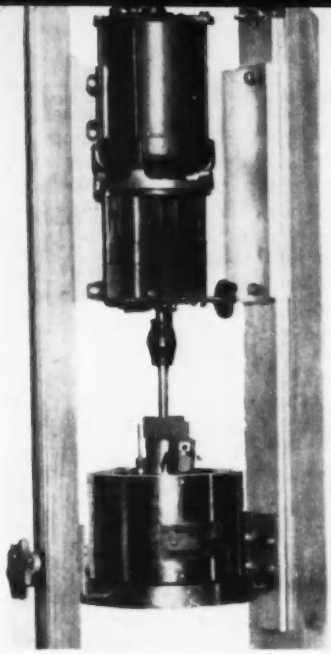
The new equipment will be made available for research by neighboring institutions. It will operate under Dr. William E. Stephens, professor of physics.

Technetium Melting Point 4,000 Degrees

➤ ONE MORE constant of nature has been determined. The melting point of technetium, element 43, the first element made in the laboratory by man, has been found for the first time. It is within 50 degrees of 2,200 degrees centigrade (about 4,000 degrees Fahrenheit).

The determination was made on a fraction of an ounce of the element loaned to British scientists at the University of Oxford by the U. S. Atomic Energy Commission at Oak Ridge, Tenn. It was made by Drs. E. Anderson, R. A. Buckley, A Hellawell and W. Hume-Rothery, who reported results in the journal Nature.

Technetium does not occur naturally on earth. It has been found in stars, including the sun, and is produced artificially as a radioactive substance by atomic bombardment of molybdenum or as a fission product in nuclear reactors.



Apparatus Article

New Membrane Cell

➤ A NEW laboratory-scale membrane permeation cell incorporating recent developments in using selectively permeable membranes for changing the composition and separating components of fluid mixtures is available from Ionics, Incorporated.

Membrane permeation is a new unit operation utilizing membranes which permit easier passage of one or more of the components of a mixture relative to the remaining component. Appropriate selection of membranes and operating conditions such as temperature and pressure make possible the effective separation, for commercial purposes, of various components in industrial process streams.

Typical of the many applications which lend themselves to membrane permeation techniques are the breaking of azeotropes, separation of close-boiling mixtures, removal of water from organics and driving equilibrium reactions to completion. According to Ionics, the new permeation cell makes possible complete process research investigations of promising commercial applications in the customer's laboratory, including economic evaluations, determination of process variables and membrane selection

and development programs leading to optimum pilot plant designs and full-scale commercial processing cost estimations.

In Ionics' standard cell all metal parts in contact with fluids to be tested are made of stainless steel. Other materials can be furnished upon request.

The cell is equipped with a heating mantle, pressure gauge, thermometer well, and may be operated on a batch or continuous basis. An internal chamber provides a means for rapid cooling. If desired, the chamber also may be used as an alternative heating or temperature control system. A variable-speed stirrer promotes uniform temperature and composition throughout the charge.

Optionally available accessories include a vacuum pump, condensers, glassware, etc., and permit "plug-in" operation of the cell.

For additional information on the laboratory equipment or on the membrane permeation process, write Ionics, Inc., 152 Sixth St., Cambridge 42, Mass.

Sound Waves Measure Fast Reactions

➤ SOUND WAVES can be used to measure more accurately the rates of fast chemical reactions, it has been found by a physicist at the University of California, Los Angeles.

Chemical reaction rates, the speed at which gases, liquids and solids combine or separate, are basic to an understanding of most substances and processes — from the formation of water to the workings of an internal combustion engine.

One way of measuring very fast reaction rates, those that occur in one-millionth of a second, is through sound waves, whose velocities change with the time of reactions.

Using a complex apparatus, UCLA research physicist Harvey Blend has developed a method for detecting very small changes in sound wave length and velocity, which in turn allows him to measure reaction rates more accurately.

Through a combination of optical, acoustical and electronic techniques, Mr. Blend has been able to measure changes in wavelength of two thousand five hundredths of an inch, and changes in frequency of one cycle in a million. These measurements, taken together, represent a new high in accuracy.

In his apparatus, which he largely designed himself, Mr. Blend used two transducers to generate and receive sound waves. He sent his waves in short bursts to eliminate the echoes which had clouded measurements of earlier researchers.

By perfecting his measurements, Mr. Blend hopes to throw more light on the mechanism of chemical reactions, especially how molecules combine and separate during reactions.

Rare Chemical from American Coal

➤ RESEARCHERS of the Bureau of Mines have discovered that the rare chemical coronene can be produced during the conversion of certain American coals to pipeline gas, the Department of the Interior announced recently.

Heretofore the scientific world had been able to obtain coronene only by complicated processes, chiefly the hydrogenation of coal into liquid fuels, but coronene never had been detected in American coals.

Bureau chemists recently encountered the characteristic needle-like crystals of coronene while using a simpler hydrogenation technique for making pipeline gas from coal. The discovery occurred while tests were being run on powdered anthracite from Luzerne County, Pennsylvania.

Coronene was produced by the Germans during World War II as a by-product from complex plants built to make synthetic gasoline and other liquid fuels from coal for the Nazi military machine. Coronene so obtained was used as a base for dyes.

Destruction of many of the German synthetic fuels plants during the war, the failure to rebuild them, and the abandonment of remaining plants following return to peacetime imports of petroleum, automatically ended the output of coronene in Germany.

The recovery of coronene from Pennsylvania anthracite was at a rate of one pound per 1,000 pounds of coal. Since coronene never has been used commercially in the United States and because its market cost of $2 to $3 a pound places it in an unfavorable competitive position with other dye bases, the Bureau does not forecast a rosy future for coronene in the next few years.

The agency did point out, however, that should the production of pipeline gas from anthracite become commercially feasible, the simultaneous recovery of coronene could help underwrite the cost of gasification.

The coronene recovered by chemists in the Bureau's research laboratories at Bruceton, Pa., near Pittsburgh, proved extremely pure. For fellow scientists, they describe it as "a hydrocarbon consisting of a ring, or crown, of six benzene rings." They add that it has an exceptionally high melting point for a hydrocarbon and is quite stable and relatively inert.

One of the significant features in connection with the recovery of coronene at Bruceton was that it was found only during the processing of anthracite. Bituminous coal or char (partly carbonized bituminous coal) did not yield the chemical.

√ Answers to CHEMISTRY QUIZ on Page 14. √

A - 1; B - 2; C - 2; D - 1; E - 2.

Russia Far Behind U.S.

➤ SOVIET SCIENCE is far behind that of the United States, despite Russian achievements in space.

This is the opinion of the Princeton professor of chemistry, Dr. John Turkevich, who was recently science attache at the American Embassy in Moscow.

In an oral report to the National Science Foundation he said that both Russian politicians and scientists recognize U. S. scientific superiority. The United States has "the most powerful and aggressive group of scientists and science programs, and the best-equipped laboratories in the world."

Dr. Turkevich was notably unimpressed with Soviet science generally and charged that neither their equipment in science nor talent matched ours. "For every good man they have, we have ten."

Even Soviet Premier Khrushchev acknowledges this superiority, he said. Last year, in a conversation with the Soviet leader on U. S. ability in space, Dr. Turkevich asserted that eventually the U. S. would beat the Soviets in their launch ability. Khrushchev responed: "America is powerful and strong. If Americans put their mind to beating us, they can do it."

Officially, the Communists insist that Sputnik has proved that science can advance faster under a communist system. Dr. Turkevich said his experiences in Russia convinced him that the Soviet people had more faith in science and technology as a way of life than Marxism. A tremendous concentration upward on outer space, rather than communism, better explains Soviet advances in this area.

Actually, their system as applied to science and technology "is so inefficient that they cannot put anything on the road" despite their impressive launches, he said. "There is not nearly as much basic research being done in Russia as in the United States," the science diplomat said. "They have had notable failures about which they are quiet."

Prominent among these is "their 30,000-ton white elephant," the 10 BEV (billion electron volt) atomic accelerator, virtually ineffective because of faulty construction that may be attributed to undue haste in an attempt to outdo the U. S.

"Sometimes, especially in science, it pays to go slowly," said Dr. Turkevich, pointing to the success of the accelerators at Brookhaven National Laboratory and the Stanford accelerator, both in full and successful operation.

He credited the national concentration in the Soviet Union on science to the large number of engineers and scientists prominent in their government.

Soviet and American space achievements have been compared to an alarm clock and a small Swiss watch. Dr. Turkevich said the comparison is apt, except that it should be added that "It was the Soviet alarm clock that woke America up to make the Swiss watch."

He decried the tendency of Americans to sell their science achievements short. But he also warned against complacency. The present weakness in Soviet science only "gives us breathing space."

Flexing Increases Strength

➤ SCIENTISTS are baffled by a new molded plastic hinge that gets stronger each time it is used, according to Russell D. Hanna, Hercules Powder Company plastics expert.

Molded hinges made of polypropylene, a tough, lightweight new plastic, have been subjected to tests involving 1,000,000 flexes "with no evidence of failure," Mr. Hanna told the 17th annual technical conference of the Society of Plastics Engineers, Inc.

Repeated flexing of polypropylene hinges "actually increases the tensile strength of the plastic; and, although we have theories," the speaker said, "precise reasons for this have not been determined."

This unusual property in polypropylene has resulted in the manufacture of a wide variety of new containers, such as cases for eyeglasses or phonograph records with molded-in hinges, Mr. Hanna said. "Molded-in" means the hinge, lid and main section of the container comprise a single plastic unit. Although the hinge is often membrane-thin, Mr. Hanna said, it possesses "virtually unlimited flex life."

Polypropylene accelerator pedals are being evaluated by all major automobile manufacturers, the speaker said. Preliminary studies indicate "a reduction of between 50 and 70 per cent in initial cost, better wear and abrasion resistance, and additional economies in accessory parts and assembly time.

Air deflection registers for car air-conditioners have already been redesigned to make use of the polypropylene integrally-molded hinge. The switch-over trimmed reduction costs by 66 per cent, cut assembly time by 68 per cent, and reduced the weight of the unit by 92.5 per cent.

"Other thermoplastics, such as high-density polyethylene, have several of polypropylene's characteristics," Mr. Hanna concluded, "but none appears to provide the balance of properties required to give hinge performance comparable to that of polypropylene."

Mr. Hanna is superintendent of the technical service plastics laboratory at Hercules' Parlin, New Jersey, polyolefins plant.

"Positive" Approach Prevents Corrosion

➤ CORROSION is prevented in the chemical process industry by placing a positive charge on the metal to be protected in a new approach to the problem.

Carl E. Lock, Merle Hutchison and Norman L. Conger of the Continental Oil Company, Ponca City, Okla., reported to the meeting of the American Institute of Chemical Engineers that such a positive charge produces "passivity" in the metal. This method is called anodic protection. Anodic protection has been successfully applied to the sulfuric acid industry.

Olin Mathieson

This is the sixth of a series of eight articles to be presented in this volume of CHEMISTRY. Many of the students now preparing for a career in chemistry will eventually join one or other of the large corporations and this series, featuring the major companies employing chemists in the United States, is intended as a preview into the type work that they will be doing.

➤ In 1892, Franklin W. Olin founded a small company to produce black powder for the Illinois coal fields. In the same year, another company, the Mathieson Alkali Works, was established in Saltville, Virginia. Both companies grew at approximately the same rate in the following years. Their interests also grew closer together, and slightly more than a half century after their founding the two companies merged to form Olin Mathieson Chemical Corporation.

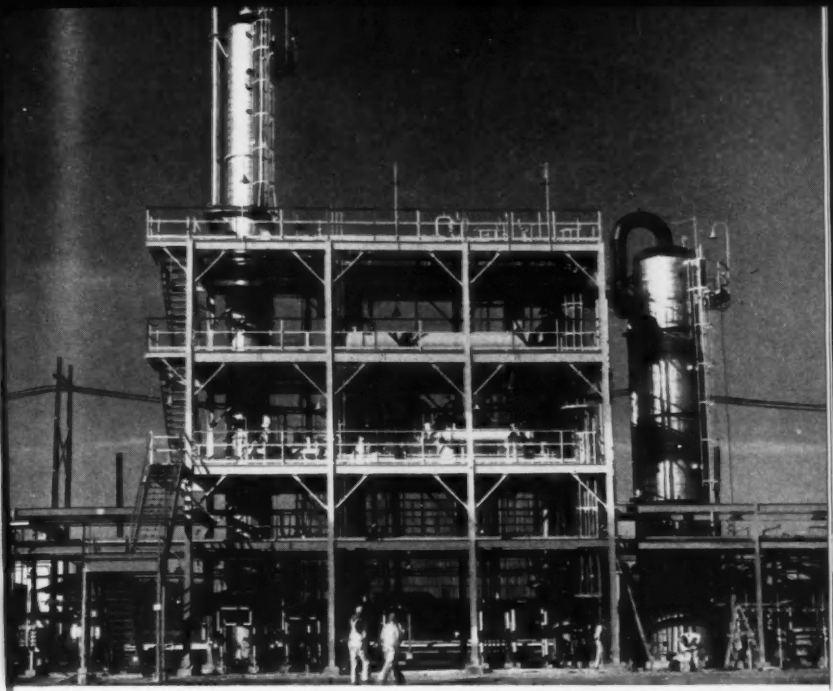
Olin is organized in seven major divisions: Chemicals, Metals, Packaging, Energy, Squibb, Winchester-Western, and International. In addition, the corporation is joint owner of Ormet Corporation, a producer of alumina and aluminum, and of SunOlin Chemical Company, a manufacturer of urea and related agricultural products.

While Olin is a highly diversified company, its strength lies in the relationship of its interests. The activities of one area of operations complement those of another, leading to a cross-pollination that provides mutual rewards in research and sales.

For example, one of the original interests of the company, blasting powder, led naturally into sporting ammunition which, in turn, led to sporting arms and the creation of what is now the Winchester-Western Division. Similarly, the cellulose chemistry of explosives led into the cellophane and paper fields and, ultimately, the company's Packaging Division.

The problem of working with metals to the fine tolerances required in ammunition manufacture led to entry into the production of brass and other copper-base alloys and, most recently, primary aluminum, of which the company's Metals Division is now the nation's fourth largest producer. Chemicals led to an interest in pharmaceuticals and medicinals and the establishment of a strong position in the drug manufacture field through E. R. Squibb & Sons.

Within its six basic fields of interest, Olin manufactures thousands of products which are sold throughout the world by the company's International Division.



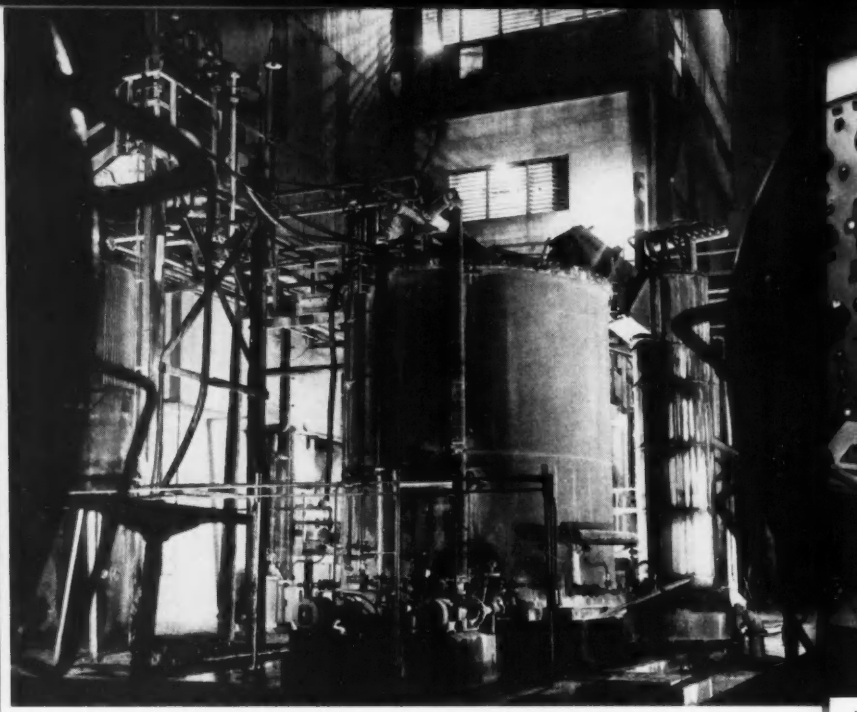
➤ PROPYLENE GLYCOL, *a clear, colorless liquid, is made in this unit at the Olin Mathieson Chemical Corporation plant at Brandenburg, Kentucky. The chemical is used as a food preservative and to give food a good appearance. It is also a moistening agent which helps keep tobacco, bread and other products fresh, and serves as a plasticizer for cellophane.*

Research

In any chemical company, however, the measure must be not today's product, which is already on the road to obsolesence, but the products that are about to be born or are in mind for tomorrow. At Olin, where at least one new product is born every week, research projects are conceived almost daily. Research represents the efforts of nearly 1,000 scientists, engineers and technicians, and an expenditure of $28,000,000 a year.

Pharmaceutical research is carried out at The Squibb Institute for Medical Research at New Brunswick, New Jersey, recognized as one of the outstanding research centers of its kind. Other specialized laboratories are maintained at various plant locations throughout the country. But the major research efforts of the corporation are consolidated at New Haven, Connecticut.

While each division pursues its goals more or less autonomously, this



➤ AMMONIA *and phosphoric acid are joined in this primary reactor to make Ammo-Phos, the high analysis fertilizer manufactured by Olin Mathieson Chemical Corporation. The plant at Pasadena, Texas, is the largest of its kind in the world.*

centralization offers the scientist numerous advantages. Besides providing a stimulating climate for the exchange of ideas with those in other fields, it makes economically possible, by the pooling of resources, the maintenance of one of industry's most completely equipped analytical laboratories as well as one of the fastest analytical services.

To what specific ends is Olin research dedicated? What are the opportunities for the chemist, the technician, and the research scientist, in this company? The range is as wide as the company's divisional interests.

Energy

In this field, Olin's major concern is with nuclear fuels, propellants and explosives. The search is not only for new primary sources of energy but, also, new ways to package energy in

➤ A TECHNICIAN *in the Metallurgical Research Laboratories of Olin Mathieson Chemical Corporation, New Haven, Connecticut, uses an electron beam welder to weld materials in a vacuum.*

easy-to-use forms, such as a thermal battery that can be stored indefinitely or an explosive switch to trigger the delicate instruments of a satellite. One of the most common forms of packaged energy is the explosive used for mining, construction, or the clearing of new waterways and the carving of highways. Special explosive formulations are sought for more efficient oil well, seismographic and underwater work.

Ever more efficient solid and liquid propellants are looked for to permit heavier payloads in rockets and missiles.

Olin's stake in the nuclear field embraces fuel elements and reactor cores — the energy source for such pioneering efforts as the first submarine to break ice at the North Pole, the first nuclear aircraft carrier, and the Army's experimental camp situated entirely under the Greenland ice cap.

Investigation also focuses on other energy systems, such as electron transfer and thermoelectric generators

which directly convert into energy heat from sources such as the gas flame and nuclear activity. Tangentially, the search is for materials to contain energy — the synthetic materials and heat transfer fluids capable of withstanding the tremendous temperatures of nuclear bombardment and eventually make possible such things as atomic automobiles and manned flights to the stars.

Winchester Western

This division of Olin manufactures the most complete line of firearms and ammunition for the sportsman. Chemists, ballisticians, engineers, designers and other technicians seek new formulations and mechanical principles to send the bullet faster and further with greater accuracy and shocking power.

Another goal is to reduce recoil while, at the same time, finding new materials to make guns stronger and lighter. A recent significant advance in this direction was the development of the Model 59 glass barrel shotgun. Made of 500 miles of fiber glass wound around a thin steel liner and treated in a vacuum with specially developed epoxy resins, it is superior to full steel barrels in every functional respect from weight to burst strength.

By harnessing the explosive power of blank cartridges, ammunition research is also developing radical new tools for industry: powder-actuated fastening tools which join materials together or form them into complicated shapes with the simple pull of a trigger; accelerated propellant gases for metal forming; small cartridge packages for increasing efficiency of power tools while reducing noise levels; miniature compact reciprocating stroke tools that operate over long time spans.

Metals

Besides being one of the leading producers of primary aluminum, Olin is one of the nation's most important producers of tailor-made brass and other copper-base alloys, maintaining the world's largest sheet and strip brass mill. The company produces more than 40 different copper-base alloys, principally brass, bronze, phosphor bronze and nickel silver. More than 4,000 parts are fabricated, and metal is supplied for tens of thousands of parts made by other manufacturers.

The Olin chemist and metallurgist today seeks ways to build new properties in alloys by manipulating the internal structure of the metal itself; ways to make aluminum stronger at higher temperatures, to make brass stainless, to create satin or shiny finishes, and to tailor-make alloys for highly specialized uses — stiff lightweight metals, for example, to protect astronauts from cosmic rays.

The search might be for a superior aluminum alloy that will not crack under great tensile load . . . Or for a protective coating that will never corrode or lose its lustre . . . Or for a better resin for adhesive bonding, such as the development that led to aircraft with bonded propellers and bonded fuselages entirely free of rivets or weldments.

Metals, once a field of limited creative interest, now poses one of the most challenging areas for scientific investigation. In the past three decades the number of usable metals has tripled, the number of alloys has multiplied at an unprecedented rate,

known metals have revealed new properties as a result of ultrapurification and are even being used for superfuels in the marriage of organics and inorganics.

Packaging

Olin is a fully integrated manufacturer of packaging products ranging from cellophane and polyethylene to a complete line of kraft paper and board, lumber and lightweight printing, specialty and cigarette papers.

The stress of the Packaging Division is on developing materials to do special jobs, such as the Waylite lightweight papers — whose unusual strength and opacity make them the first lightweight papers eminently suited for offset and letter-press printing — or new coatings for film to package perishable goods.

The chemist is called upon to explore such factors as those that influence a material's softness, stiffness, thickness, weight, and ability to take printing and adhesives. The goal might be the development of a brand new packaging material from nylon fibers; or the development of a gilding solution that does not cause Bible pages to stick together; or a more efficient cigarette filter or tipping paper that will not stick to the lips in extreme cold areas.

Materials basic to packaging have other potential uses. Polyethylene is used in construction for a moisture barrier, and in agriculture for mulching and fumigation.

The discovery of a new material such as a thermoplastic film to compete with cellophane and polyethylene has wide significance, therefore, even beyond the limits of the $16,000,000,000-a-year packaging industry.

Squibb

The E. R. Squibb & Sons Division of Olin produces 85 per cent of the ether used by the nation's hospitals, large supplies of lifesaving insulin, hypotensive and tranquilizing agents, nutritional products, hormones, and many other therapeutic agents. It produces much of the medical profession's supply of streptomycin and penicillin, which was first crystallized in Squibb laboratories. Squibb also developed Nydrazid, the most effective antituberculosis drug, curare products for surgery, and Raudixin for hypertension.

Some of its more recent significant products are Mycostatin, an anti-fungal antibiotic; Mysteclin, a broad-spectrum antibiotic which kills both bacteria and secondary fungus growths; Naturetin, an effective diuretic; and Rautrex-N, one of the most effective drugs in use today to combat hypertension.

Squibb was among the first in the pharmaceutical industry to investigate the properties and uses of isotopes, and is today one of the two major producers of radiopharmaceuticals in the United States.

The emphasis on research at Squibb is underscored by the fact that half the products in the division's line were unknown a decade ago. The push for new drugs to cure disease and maintain health takes place on many frontiers, from psychopharmacology and neuropharmacology to the screening of folk remedies and the search for a cure for cancer. Squibb,

in fact, has one of the largest government contracts for research on anti-cancer steroids.

Chemicals

The largest single division of Olin is Chemicals, and its activities encompass both the organic and inorganic fields. The company is a leading producer of agricultural chemicals, including the new high analysis fertilizers, and many of the heavy chemicals for industry such as soda ash, caustic soda, synthetic ammonia, chlorine, sulphuric acid and sodium phosphates.

A second major phase of the chemicals operation is the production of organic chemicals, carbon-base compounds made from natural gas which is separated into ethane, propane, butane, and natural gasoline, then sold in bulk or further processed into a variety of finished chemicals. The company is also deeply engaged in such challenging new fields as polymers and organo-metallics, where the interests of organic and inorganic chemistry overlap.

The chemist's field is limitless, ranging from finding ways to grow better crops to the creation of new products for housing, health, clothing, industry, and leisure.

The task of the chemical researcher at Olin is, most simply, to discover new and better ways to extract from nature the basic elements; recombine them into new compounds; and find uses for the compounds and by-products that spring up along the way.

Atomic Developments Advance Cancer Research

➤ CANCER RESEARCH and industry have been advanced by two achievements in atomic development at Oak Ridge National Laboratory in Tennessee: more economical production of cobalt-60, lowering consumer costs 80 per cent, and the first known separation of gram quantities of osmium isotopes.

Better production methods for cobalt-60 developed by the Atomic Energy Commission at Oak Ridge allow the Government to make a profit on sales even at reduced prices.

This should encourage private commercial production, John Maddox, AEC isotope distribution specialist, told Science Service. The Government would prefer that nuclear development become a function of private industry.

Cobalt-60 is a valued tool in the treatment of deep-seated cancers, sterilization and food preservation. It is used by industry for detecting structural defects in metal products, and in the production of plastics.

The stable osmium, now available for the first time in significant quantities, is of particular value in basic research. It will be used as a tracer to shed new light on the behavior and composition of matter, AEC scientists predict.

New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupon (but not stamps) for each patent ordered.

Recovery of ACTH and Oxytocin from Pituitaries

➤ THE PITUITARY GLAND produces several hormones of considerable importance to the medical profession. Previous methods of extraction provide for the recovery of ACTH only during the processing of pituitary glands. Oxytocin and vasopressin are hormones produced by the posterior lobe of the pituitary gland. They are desired for use by the medical profession.

U. S. Patent No. 2,910,404 has been issued to Mr. Bernard J. Baltes of Chicago and Mr. Sanford L. Steelman of Elmhurst, Illinois for a new process which permits the recovery of ACTH, oxytocin and vasopressin from the same batch of pituitary material. This process is particularly important since the preparation of ACTH previously has utilized all of the available hog pituitary glands causing both oxytocin and vasopressin to be lost.

In this new process the pituitary material is extracted with 80 per cent acetone-water solution acidified with hydrochloric acid to a pH of about 1.5. To the solution obtained in this manner acetone is added to bring its concentration to 90-92 per cent. Crude ACTH precipitates out at this point. The acetone concentration of the remaining soluution is reduced to below 5 per cent by distillation under reduced pressure. The pH of the concentrated solution is adjusted to 3.5 by the addition of 5 N NaOH.

Extraction of the adjusted solution with butanol removes the oxytocin leaving vasopressin in the water phase. The crude ACTH as well as the butanol solution of oxytocin and the aqueous solution of vasopressin are processed further according to accepted procedures.

The inventors assigned this patent to Armour and Company of Chicago, Illinois.

Organo-Silicon Compounds For Permanent Waves

➤ THE SO-CALLED permanent wave is given to hair by either or both of two treatments. One is by use of a chemical agent that softens the keratin of the hair temporarily while the reshaping process takes place. The other is by use of a chemical agent that places a thin, semi-rigid coating around the individual hairs to hold the desired configuration.

Both of these processes occur with the use of a new series of organo-silicon compounds invented by Mr. Roger Charle of Soisy-sous-Montmorency, Mr. Roger Ritter and Mr. Gregoire Kalopissis of Paris, France. They were awarded U. S. Patent No. 2,944,942 for the preparation of these compounds and their use in permanent-waving.

They describe the preparation of trimethylsilyl monomercaptoacetate, dimethylsilyl dimercaptoacetate and monomethylsilyl trimercaptoacetate. When used in a permanent wave solution mercaptoacetic acid and polymeric silanols are produced. The first product softens the keratin of the hair while the second forms a coating around each hair. The result is a greater luster of the hair.

Detection of Reactor Insulation Failure

➤ THE CARBON STEEL used in the construction of reaction vessels in the petroleum industry is subject to failure if exposed to temperatures above 550-600 degrees F. A new invention provides paint that changes color when exposed to a temperature of 510-630 degrees F. within a period of one hour. Their color changes from green or blue to white. This enables the operating crews to know when the temperature must be adjusted.

Mr. Jacques Benveniste of Union, Mr. Charles P. West of Metuchen, N. J., and Mr. Harvey N. Lieberman of Bronx, N. Y., found that the pigment copper phthalo cyanine changes from royal blue to white at a temperature of 530-570 degrees F. in the presence of methyl-phenyl and dimethyl silicone resins. They also found that monochlorinated copper phthalo cyanine changes from green to white at a temperature of 475-630 degrees F.

Firebrick is used to insulate the carbon steel from the intense heat of the reaction vessels. The breakdown of insulating material causes the steel to be overheated. The patent has been assigned to Esso Research and Engineering Company of Delaware.

Asphalt

➤ ASPHALT — the ancient petroleum product that caulked Noah's Ark and waterproofed the basket in which Moses was found floating among the bullrushes — is developing into a material of unsuspected versatility in the twentieth century.

According to the magazine *Petroleum Today,* scientists are constantly expanding uses for the dark sticky substance which has been known since around 3800 B. C. and has been called by such names as asphaltum, bitumen, pitch and tar.

Road construction accounts for 70 per cent of United States production of asphalt. Some 90 per cent of all U. S. paved roads are asphalt surfaced, in fact.

The next largest use of asphalt is for roofs, with something like six out of seven using some form of the material.

In semi-arid regions as much as a third of the irrigation water is lost through seepage from canals and ditches. The newest technique to combat this involves the use of asphalt-coated burlap sheets to line irrigation ditches.

Some other places where asphalt turns up are:

Clay pigeons, brake linings, tires, paints, upholstery, inks, electrical insulation, pipe coatings, dressings for tree surgery, disposable flower pots, paper bags, waterproof tennis courts, auto battery cases, auto undercoating, ship bottoms and waterproof papers.

Creative Ability

▶ YOUR CHILD'S C. Q. (creativity quotient) is related to his sense of humor. Research by Prof. Jacob W. Getzels and Prof. Philip W. Jackson of the University of Chicago points to development of a "creativity quotient" similar to the I. Q. system of ratings now in use.

For their research on giftedness, they used a group of about 500 adolescents in the University of Chicago Laboratory School from the sixth grade to the end of the senior year in high school. They found that the emphasis on sense of humor is so marked that it is the one characteristic that sharply sets apart the high-creativity group from all other groups. Their research also disclosed that teachers prefer the high I. Q. child to the child with the high C. Q. The highly creative child studied was selected only if he was not in the top 20% in I. Q. The high I. Q. child and the high C. Q. child were equally superior in school achievement to the student population as a whole.

"This is Fred's hobby room!"

Proudly Presented

Announcing new developments in the chemical industry and newly available chemical literature.

Styrene-Butadiene New Synthetic Rubber

➤ A NEW styrene-butadiene synthetic rubber with exceptional light color and outstanding physical properties has been developed by the Chemical division of The Goodyear Tire & Rubber Company.

Stabilized with a non-staining, non-discoloring antioxidant, the new material, Plioflex 1510, has low viscosity, giving it easy processing and good mold flow characteristics, according to M. J. Rhoad, manager of the Rubber and Rubber Chemicals department.

Excellent color suggests use of Plioflex 1510 in closed cell sponge rubber products, flooring, sporting, household and related goods that require high color standards.

The new material exhibits excellent physical properties when compounded, a feature normally not associated with a low viscosity rubber, Rhoad said.

Produced at the company's Houston, Tex., synthetic plant under refined quality control standards, Plioflex 1510 is marketed with assured processability for end product manufacturers, he explained.

Melamine Plant Planned by Allied

➤ ALLIED Chemical Corporation announced recently facilities will be installed for the production of melamine crystal by its Nitrogen Division.

Melamine crystal is the base for a number of important resins used for dinnerware, laminating, coating and molded products. Allied's Plastics Division is one of the largest producers of melamine molding resins in this country and recently doubled capacity at Toledo, Ohio.

The new melamine facilities will have a capacity to produce upwards of 20 million pounds of melamine crystal per year. This will be sufficient to supply the requirements of Allied's Plastics Division and also provide a substantial quantity for sale to other melamine consumers.

The new plant, which is expected to be completed by the early part of 1962, will produce melamine crystal from urea by process developed by Nitrogen Division's research organization. License has been obtained by Allied Chemical from American Cyanamid Company for the basic patents covering the production of melamine crystal from urea.

Foaming Agent For Well Drilling

➤ DEVELOPMENT of a new and highly effective foaming agent for use in air drilling of oil wells beset by water encroachment is announced by Armours Industrial Chemical Company.

The product is a liquid cationic surfactant called Armomist. It will produce large quantities of a stable, light density foam and is not affected by high concentrations of dissolved

solids. Besides its foaming action, it has corrosion inhibiting properties and also works well as a shale conditioning agent.

Armomist is a highly fluid substance with a pour point below 0 degree F so that it can be used at extremely low temperatures. It may be injected in the air stream either directly or in a carrying medium of lime water.

The foam is lifted up the annulus and blown out through the "blooie" line. Each mist-drilled well probably will require slightly different concentrations. However, according to present experience, it appears that 0.15 to 0.20 per cent Armomist, based on the total water discharged out the blooie line, is sufficient.

Armomist has the ability to lower the surface tension of water and it is effective even where the encountered water has a high salt content. Field tests indicate the product also tends to prevent the sides of the hole from collapsing.

It has been estimated that approximately one-third of the oil wells being drilled are conducive to air drilling. The principal objection to the air method is the water problem, since small quantities of water cause sand and shale dislodged by the drilling bit to ball up and possibly stick in the drill pipe, while large quantities make the operation uneconomical.

For purposes of description, water intrusion may be divided into three categories, depending on the amount of flow:

1. "Weeping flow" which results in 2 to 4 barrels of water per hour entering the well;

2. "Medium flow" which would be in the order of 5 to 50 barrels an hour; and

3. "High flow" which would be greater than 50 barrels an hour.

Armomist appears to be most effective in the medium flow range.

Computer Controlled Cat Cracker

➤ THE FIRST known use of "Closed-Loop" automatic computer control of a catalytic cracking unit will be instituted at Gulf Oil Corporation's Philadelphia Refinery early in 1961.

One of the larger fluid catalytic cracking units ("Cat Cracker") in the country, Gulf's 60,000 barrel-per-day unit at Philadelphia, will be automatically controlled by a Thompson Ramo Wooldridge Digital Computer, the RW-300.

Closed-loop computer control is a system through which significant variables are automatically controlled, usually at some optimum value, by a computer on the basis of operating measurements automatically fed into it.

Gulf engineers and scientists began looking at the possibilities for the application of computer control to refining processes some two years ago, and since October of 1959 have been working with scientists of the TRW Computers Company on an intensive process analysis, programming effort, and "hardware" engineering.

Principal products of the Cat Cracker at Philadelphia are high octane gasoline stocks, liquid butanes, liquid propanes, and household and industrial fuel oils.

For the Home Lab

Butyric Acid

by Burton L. Hawk

Prologue:

Butyric acid has one outstanding characteristic: *it stinks!*

Occurrence:

The free acid is found in rancid butter, Limburger cheese, perspiration and feces. In fact, it is one of the ingredients that contribute to the undesirable odor of these materials. It is formed in the fermentation of sugars, fats and other substances. The micro-organism present in Limburger cheese is capable of converting lactic acid (the constituent of sour milk) into butyric acid (the constituent of rancid butter).

Fruit Bowl:

Realizing that chemistry is a crazy science, it is entirely logical that a disagreeable smelling substance such as butyric acid is used to prepare the essence of fruit flavors and perfumes. So be it.

Mix together in a small flask 2 cc. of butyric acid and 2 cc. of ethyl alcohol. Carefully add about 5 drops of concentrated sulfuric acid. Stir thoroughly and apply gentle heat. Continue heating and allow the mixture to boil slowly for several minutes. After cooling slightly, pour the mixture into a beaker filled with water. Stir and smell cautiously at the mouth of the beaker. Do you recognize the odor of pineapples? This is ethyl butyrate, commonly known as "pineapple oil." Remember these odors are best destermined when the solutions are dilute.

Mix together in a small flask 2 cc. of butyric acid and 2 cc. of butyl alcohol. As before, add 5 drops of sulfuric acid; heat and then pour into a quantity of water. Stir and smell cautiously. Can you recognize the odor of cherries? This odor is not quite as pronounced as that of pineapples. The compound is butyl butyrate.

Repeat the above experiment this time using isoamyl alcohol. The material obtained now is isoamyl butyrate and it has the odor of pears.

Preparation from Butyl Alcohol:

Butyric acid can be obtained by the oxidation of butyl alcohol. Dissolve 1 gram of sodium or potassium dichromate in 10 cc. of water and add 1 cc. of concentrated sulfuric acid. Stir and allow the solution to cool. Then add 2 cc. of butyl alcohol. The liquid darkens rapidly and grows quite warm. After all action ceases, heat gently for a few minutes. Remove from the flame and very carefully smell at the mouth of the tube. You should be able to detect the odor of butyric acid; if not, the oxidation has not progressed far enough and it will be necessary to heat again.

Nostalgia:

A little less than fifteen years ago, the first article in this long series was mailed to the Editor of Chemistry Magazine. That article described the preparation of butyric acid and pineapple oil from butter. It is somewhat frightening when one considers just

how fast these years have slid by! During that time we were struggling to regain normal life after the costliest war in history. Young men were still returning from all parts of the globe . . . . some today, some tomorrow, and others would never return. Rationing was still in effect then, and butter was one of the rationed foods. And we wondered then just how many readers would part with a portion of their precious butter to prepare pineapple oil. And we wonder now how many of you reading this have read that. Probably not many, and, thus, after fifteen years, we feel justified in a bit of repetition. Times are different now. We have returned to normalcy plus. Butter is available in plenty to everyone who can afford it, and most everyone can. So much for the past . . . . it is gone, it can not be regained. Now we look to the next fifteen years. What will they bring?

Preparation from Butter:

Most butters contain approximately two per cent of the glyceryl ester of butyric acid. Our first step is to break up this compound by treatment with heat and alkali, a process known as *saponification*. Melt a teaspoonful of butter in an evaporating dish. Continue heating and stirring as you add one gram of potassium carbonate. Add in small quantities. The fumes are somewhat irritating, so keep your face away. After all the carbonate has been added, continue heating the mixture. By this time the butric ester should have been converted into potassium butyrate.

Remove the butter mixture from the flame and add a *small* quantity of dilute sulfuric acid. Continue adding the dilute acid in small quantities until all action ceases. By this time the potassium butyrate should be converted to butyric acid. To obtain the latter, the mixture is distilled. Transfer the butter mixture to a test tube. Insert a one-hole stopper containing a piece of glass tubing which leads to another test tube, externally cooled by immersion in a container of cold water. Heat the butter mixture until about one-half of the portion distils over Butyric acid boils at 162 deg. and condenses in the cool receiving tube.

Epilogue:

Butyric acid has one outstanding characteristic: *it stinks!*

Atom Smasher for NBS

➤ A $1,700,000 accelerator that can hurl an intense beam of electrons at speeds close to the velocity of light with a very high precision will be built for the National Bureau of Standards in Washington, D. C. The intense source of electrons will provide the NBS with greatly advanced research and engineering capabilities. The new linear electron accelerator, or Linac, will be 100,000 times more powerful than existing NBS high energy equipment. Measuring 100 feet in length, Linac will produce electron beams with peak energies up to 150,000,000 electron volts and power outputs of 40 kilowatts or more.

It will be built by the High Voltage Engineering Corporation, Burlington, Mass.

Science Talent Search
Project Report

A Linear Accelerator

by JAMES WARREN ROWLAND, JR.

James Warren Rowland, Jr., 18, was a winner in the 19th Science Talent Search. He plans to study physics in college in order to become a nuclear physicist.

➤ IN MY STUDY of chemistry and physics during the last several years, I have become interested in the design and operation of machines commonly known as "atom smashers." After further investigation and careful consideration of the problems involved in each kind, I decided to construct a linear accelerator.

There are four basic types of these accelerators, all consisting of a particle source, a vacuum tank, an electronic system, and some type of electrodes or coil. I decided to design mine according to the principles set forth in the original model invented by E. O. Lawrence and D. H. Sloan in 1931.

Theory of Operation

The operation of the linear accelerator depends upon the attraction of unlike charges and the repulsion of like charges. A charged particle enters a gap between two charged electrodes. It is, therefore, attracted to the one having the charge opposite its own. Because the kinetic energy is proportional to the square root of the velocity, and the energy gain of the particle is linear, the electrodes are cut in the ratio of $\sqrt{1}: \sqrt{2}: \sqrt{3} \ldots$ except in situations where the speed becomes high enough for the relativistic increase in mass to become noticeable. At the highest powers, the electrodes and gap lengths become almost constant since the energy then goes mostly into increasing the mass instead of the speed. As the particle "P" passes electrode 1, electrode 1 becomes positive and electrode 2 becomes negative. This causes the particle to be repelled from number 1 and attracted toward number 2, assuming a positive particle is used. At the time it gets to position 2′, electrode 2 is positive, but now electrode 3 is negative, due to the switching action of the transmitter. This process continues down the tube with the particle gaining energy, i.e. the speed increasing each time a gap is crossed. The energy gained is generally expressed in electron volts, the amount gained in the gap being equal to the average voltage of the wave form during the time the gap is being crossed. At first glance it would appear that the particles would be attracted to the accelerating tubes and actually bombard them. However, an electrostatic lens is formed which focuses the particles much as a convex lens does light.

CONSTRUCTION

1. Power Supply

As its name implies, the function of the power supply is to supply the proper voltages and currents at the

▶ JAMES W. ROWLAND, JR., *18, of 404 Sunrise Lane, Rockford, Ill., with his science display takes part in an exhibit held in Washington as a feature of the nineteenth annual Science Talent Institute. James is one of the 40 Science Talent Search winners who were chosen from over 29,000 high school seniors throughout the country.*

proper times. A graph was drawn of the frequency against the accelerating voltage for the electrodes of a certain length. The 80 meter ham band was chosen because the equipment was available, and the corresponding voltage for the electrodes is not extremely high. A suitable transmitter was then constructed.[1] A rewound transformer was used to supply the voltage for the ionization chamber filament. Direct current for the hydrogen generator is supplied by a full-wave rectifier connected to a small filament transformer. An a-c outlet was installed on the accelerating platform to provide power for the vacuum pumps and any instruments necessary. Indicator lamps were put across both the main power and the dynamotor inputs to provide a definite sign

[1] A Single-Tube 75-Watt Novice Transmitter in *The Radio Amateur's Handbook*, 33rd edition (Concord, New Hampshire, The Rumford Press, 1956), pp. 172-174. Slight modifications were made in the power supply and tank circuit.

as to whether the switch is "on" or "off." A neon lamp was connected between the a-c fuse and ground to provide a fail safe indication of the position of the fuse relative to the ground.

2. Vacuum System

For the vacuum system, two refrigerator compressors and two 1/6 H. P. motors were used. Since a minimum of about 30 mm. Hg pressure is needed to actuate the valves, the intake valve on the single cylinder pump was by-passed by drilling a hole in the cylinder wall just above the top of the piston when the piston was in the lowest possible position. Both of the springs on the outlet valve were removed to reduce the pressure differential at which the valve would open. Since this pump pumps oil from both the inlet and the outlet, oil traps were installed on each line. As the valves on the twin cylinder compressor were more complicated, no hole was drilled. However, the springs on the two outlet valves were removed. To be able to estimate how much air is being removed from the system, a bubbler was added. So that the roughing pumps do not have to run all of the time, a vacuum reservoir was constructed from two gallon bottles to receive the diffusion pump's exhaust.

The diffusion pump was built at the University of Wisconsin. At first mercury was used, but due to the hazards involved with mercury vapor and the constant need for dry ice, some oil recommended by Fisher Scientific Company was substituted. In operation, the roughing pumps remove as much of the air as possible. The increasing vacuum will show up on the manometer and, when its limit of accuracy is reached, the presence of air may be detected by the changing colors of a high voltage discharge inside any length of glass tubing in the system. Eventually, a meter will be incorporated in the plate circuit of the ionization chamber. Since the conductance of the ionization chamber varies according to the air pressure, the meter reading may be converted into a vacuum reading. When the best possible vacuum has been attained, the valve is closed, the roughing pumps are turned off, and the diffusion pump is turned on.

In order to insure airtight joints, a transparent sealing resin was made by heating equi-molar quantities of phthalic anhydride and ethlene glycol.[2] A vacuum wax made from petroleum jelly, paraffin oil, and paraffin was also used.

3. Accelerating Tube and Associated Equipment

I used hydrogen as my source of protons. The hydrogen is generated from distilled water to which a small amount of sulfuric acid has been added. The hydrogen is then passed through calcium chloride to remove the moisture. A small amount of cobalt chloride serves as an indicator. To avoid the leakage of air into the hydrogen, a diaphragm valve was used.

The accelerating tubes were cut from 1/4 inch ID copper tubing since it was learned that the ratio of the length of the electrode to their in-

[2] *Handbook of Chemistry and Physics*, ed. by Charles D. Hodgman, M.S., (Cleveland, Ohio, Chemical Rubber Publishing Co., 1955), p. 2988.

side diameters should be at least 10:1. I also learned that ¼ inch ID would be large enough to permit a reasonable beam and yet be small enough so that the accelerator could still be of reasonable length. Spacers for the gaps between the electrodes were assembled on a plastic base so that they could be aligned outside the tube. Polystyrene was chosen for the spacers and the base because of its electrical characteristics and its availability.

The ionization chamber consists of a tube containing a nichrome filament and a plate. It was built from a soft glass test tube. The lead-in wires were coated with borax at the point where they passed through the glass and were then sealed in.[3] Next, a length of glass was fused over each of the openings in the side to provide the hydrogen inlet and the proton outlet. The plate was then inserted, and the top was fused around the wire.

[3] The borax appears to provide a low melting point material and, therefore, reduces the time during which strains may develop between the glass and the wire.

Powerful Germ Killer

➤ THE BACTERICIDAL qualities of blue iodine, iodine in combination with polyvinyl alcohol, are many times higher than those of common iodine, according to the Soviet journal Science and Life published in Moscow.

In experiments with the blue iodine at a monkey nursery in Sukhum in the USSR, blue iodine was used after dilution to one in 80,000 parts. The experiments showed that diluted blue iodine can successfully treat and cure gastric and intestinal diseases.

Pure iodine is a dark gray crystalline substance with a metallic luster. To the non-chemist, it is familiar as a brown liquid in an alcoholic solution. When heated to moderate temperatures, iodine sublimes, forming a violet vapor that rapidly condenses to crystals on a cold surface. When added to a solution of starch, iodine produces an intense blue color. This reaction is frequently used as a test for detecting the presence of iodine.

Polyvinyl alcohol is a polymer prepared from polyvinyl acetate by the replacement of acetate groups with hydroxyl groups.

Ion Exchange Cleans Up Water

➤ DETERGENTS have been a pain in the neck to chemists involved in water purification. They have had no easy way of getting the washing chemicals placed in water upstream out of drinking water used downstream.

But Dr. I. M. Abrams reported at the American Chemical Society meeting that alkyl benzene sulfonates — the hardy part of detergents — can be almost completely removed from water by passing it through a plastic-like material A-102D, or Duolite. Dr. Abrams is a chemist with the Chemical Process Company of Redwood City, Calif.

The removal process utilizes ion exchange in which a harmless ingredient of one compound is released in exchange for the material collected.

Lung Cancer Linked to Arsenic

➤ ARSENIC in both coal smoke and cigarette smoke as a cause of lung cancer gets new emphasis from Dr. Henry S. Satterlee of Newport, N. H., in the New England Journal of Medicine.

Going back to the arsenic-poisoning epidemic of 1900 that affected 6,000 beer drinkers in the Manchester-Salford-Liverpool district of England, Dr. Satterlee applies a background feature of the investigation by the Royal Commission on Arsenical Poisoning to the flue-curing of tobacco today.

A time-honored British practice, he says, was drying the malted barley in the fumes of arsenic-containing malting fuels to impart a smoky flavor to English ales.

This cause of arsenic poisoning was further proved in 1902 when another epidemic of arsenic-beer poisoning in Halifax, Nova Scotia, was shown to be the result of using gasworks coke as a malting fuel high in arsenic content.

He says there has been a tendency to remove arsenic from serious consideration as a cancer-causing influence in city environments because it appears to be a negligible component of air pollution.

* * *

➤ DR. RICHARD A. PRINDLE, deputy chief of the U. S. Public Health Service Division of Air Pollution, minimizes the danger of arsenic in the air, in response to a Science Service inquiry.

"We regularly take samplings from the air of 31 cities across the country in a search for arsenic and other contaminating elements," Dr. Prindle said. "This as a small part of the 200 stations for sampling that we maintain because so little arsenic is found.

Dr. Prindle admitted the possibility of lung cancer being caused by the arsenic in tobacco sprays, but says without Federal regulatory authority the spraying laws are up to states.

95% Oxygen Produces Chemicals

➤ OXYGEN instead of air is being used in a new commercial process that oxidizes hydrocarbons to produce a long series of important organic chemicals at a Celanese Chemical Company plant near Bishop, Texas.

James M. Robertson of that company reported the development of the process to the meeting of the American Institute of Chemical Engineers.

Previous processes utilized air instead of the 95% pure oxygen to accomplish the oxidation of hydrocarbons.

The petrochemical industry oxidizes hydrocarbons such as propane and butane from natural gas to form a large number of aldehydes, ketones, alcohols and olefin oxides. The oxidation of hydrocarbons is one of the most important sources of these compounds which are so important to the chemical industry.

Book Condensations

FUNDAMENTAL PRINCIPLES OF BACTERIOLOGY — A. J. Salle — *McGraw*, 5th ed., 812 p., illus., $11. Completely rewritten and brought up to date, emphasizes the use of chemistry for a clearer understanding of the composition of bacteria and the reactions they produce.

BLOCK AND GRAFT POLYMERS — William J. Burlant and Allan S. Hoffman — *Reinhold*, 166 p., $7.95. Summarizes, qualitatively, the reactions and experimental techniques used to initiate block and graft polymerization and demonstrates the possibility of "molecular engineering" of polymers.

GROUP THEORY IN QUANTUM MECHANICS: An Introduction to its Present Usage — Volker Heine — *Pergamon*, 468 p., $15. Course for research students in physics and chemistry, assuming a previous course in quantum theory. Matrix algebra required is included as an appendix.

CHEM STUDY NEWSLETTER, Vol. I, No. 1 — Lloyd E. Malm, Ed. — *Chemical Education Material Study*, 4 p., quarterly, free upon request direct to publisher, Rm 457 West Hall, Harvey Mudd College, Claremont, Calif. Describes progress made in a high school chemistry curriculum study, with Glenn T. Seaborg, Chairman of Steering Committee.

QUANTITATIVE ANALYSIS — Ray U. Brumblay — *Barnes & Noble*, 235 p., illus., paper, $1.50. In outline form presents principles, procedures, examples, problems and answers.

EMBRITTLEMENT BY LIQUID METALS — W. Rostoker, J. M. McCaughey and H. Markus — *Reinhold*, 162 p., illus., $7.95. Reviews and evaluates published and some previously unpublished results of research in the field.

COMPARATIVE BIOCHEMISTRY, A Comprehensive Treatise, Vol. 1: Sources of Free Energy — Marcel Florkin and Harold S. Mason, Eds. *Academic*, 590 p., illus., $18. Deals with the sources of biologically useful free energy, such as phototropism, and the distribution and evaluation of visual systems.

ABOUT CHEMISTRY — Magnus Pyke — *Macmillan*, 219 p., illus., $4.50. Helps the layman to understand what chemistry is, how it works, and how man puts it to practical use.

NUCLEIC ACID OUTLINES, Vol. I: Structure and Metabolism — Van R. Potter — *Burgess*, 292 p., $5. Intended to provide a background and reference guide to the basic biochemistry of nucleic acids.

COLLEGE CHEMISTRY LABORATORY— M. E. Lash — *Burgess*, 122 p., paper, $2.90. To be used with first semester course in Freshman Chemistry.

OXIDE CERAMICS: Physical Chemistry and Technology — Eugene Ryshkewitch — *Academic*, 472 p., illus., $16. Deals principally with ceramics of single phase oxide systems.

ISOTOPE EFFECTS ON REACTION RATES — Lara Mclander — *Ronald*, 181 p., $6. Presents briefly the main principles of kinetic isotope effects.

THE STRUCTURE OF GLASS, Vol. 2 — A. A. Lebedev and others, E. A. Porai-Koshits, Ed., transl. from Russian — *Consultants Bureau,* 480 p., illus., $25. Proceedings of the Third All-Union Conference on the Glassy State, Leningrad, November 16-20, 1959. *Published simultaneously* in Russian by USSR Academy of Sciences.

ADVANCES IN CATALYSIS AND RELATED SUBJECTS, Vol. VII — D. D. Eley, P. W. Selwood and Paul B. Weisz, Eds. — *Academic,* 324 p., $11. Discusses surface bond, magnetic resonance, electron theory and molecular specificity in physical adsorption.

THE BOOK OF THE ATOM — Leonard de Vries, transl. from Dutch by Eric G. Breeze — *Macmillan,* 267 p., illus., by G. Van Straaten, $3.95. From alchemy to the cosmotron tells the story of man's search and discoveries.

BORON: Synthesis, Structure and Properties — J. A. Kohn, W. F. Nye and G. K. Gaule, Eds. — *Plemum Press,* 189 p., Illus., $8.50. Conference proceedings dealing with crystallization, crystal growth, structure and bonding.

INORGANIC SYNTHESIS, Vol. VI — Eugene G. Rochow, Ed. — *McGraw,* 272 p., $7.75. Covers a wide variety of substances, from active metals to isotopically labeled acids.

METABOLIC PATHWAYS, Vol. 1 (Second Edition of Chemical Pathways of Metabolism) — David M. Greenberg, Ed. — *Academic,* 572 p., illus., $18. Discusses advances in the field of metabolic processes of living organisms.

SOLID PROPELLANT ROCKET RESEARCH — Martin Summerfield, Ed., — *Academic,* 692 p., illus., $6.50. Volume 1 of a series sponsored by the American Rocket Society.

HANDBOOK OF CHEMISTRY AND PHYSICS:A Ready-Reference Book of Chemical and Physical Data — Charles D. Hodgman, Robert C. Weast and Samuel M. Selby, Eds. — *Chemical Rubber Pub. Co.,* 42nd ed., 3481 p., $12. Current scientific data in concise form.

TOXIC PHOSPHORUS ESTERS: Chemistry, Metabolism, and Biological Effects — Richard D. O'Brien — *Academic,* 434 p., $14.50. Sourcebook on organophosphate research and evaluation of the effects of poisoning in animals and plants.

ORGANOMETALLIC CHEMISTRY — H. Zeiss, Ed. — *Reinhold,* 549 p., $17.50. Monograph presents research subjects under active investigation by their respective authors.

POLYPROPYLENE — Theodore O. J. Kresser — *Reinhold,* 268 p., illus., $6.50. Brings together information on the properties, production and applications of this increasingly important thermoplastic.

GRAPHIC SURVEY OF CHEMISTRY — William Lemkin; Vinton B. Rawson, Ed. — *Oxford Bk. Co.,* rev. ed., 470 p., illus., $2.10: paper $1.25. Also contains model college entrance achievement test with explanatory comments.

THE GOLDEN BOOK OF CHEMISTRY EXPERIMENTS: How to Set Up a Home Laboratory. Over 200 Simple Experiments — Robert Brent — *Golden Press,* 112 p., illus. by Harry Lazarus, $1.95. Picture-book style introduction to experimenting.

THE ENCYCLOPEDIA OF SPECTROSCOPY — George L. Clark, Ed. — *Reinhold,* 787 p., $25. Authoritative reference to the entire field of spectroscopy, from Adsorption spectrophotometry through X-ray emission spectrometry, by more than 160 internationally recognized contributors.

INTRODUCTION TO SEMIMICRO QUALITATIVE ANALYSIS — C. H. Sorum — *Prentice-Hall,* 3d ed., 239 p., $3.50. Main changes in this edition are in the details of procedures.

ACTIVATION ANALYSIS HANDBOOK — R. C. Koch — *Academic,* 219 p., $8. Describes theory of activation analysis, irradiation facilities and preparation of samples, followed by tabulation of data for each element.

STERIC ASPECTS OF THE CHEMISTRY AND BIOCHEMISTRY OF NATURAL PRODUCTS — J. K. Grant and W. Klyne, Eds. — *Cambridge Univ. Press,* 137 p., illus., $5.50. Symposium dealing with the stereochemistry of substances of plant and animal origin.

TABLES AND NOMOGRAMS OF HYDROCHEMICAL ANALYSIS — I. Yu. Sokolov, transl. from Russian — *Consultants Bureau,* 85 p., paper, $4.35. Tables for converting water analysis from one form to another.

SILICON AND ITS BINARY SYSTEMS — A. S. Berehnoi, transl. from Russian — *Consultants Bureau,* 275 p., illus., $8.50. Critical review and evaluation of binary compounds of silicon, with bibliography covering the past 40 years.

INTRODUCTION TO CERAMICS — W. D. Kingery — *Wiley,* 781 p., illus., $15. Textbook featuring extensive descriptions of the microstructure and properties of physical ceramics as illustrative material for the application to real materials problems.

Embrittlement Inhibited

➤ ATTACHMENT of an extremely small relative amount of platinum metal to tantalum prevents hydrogen embrittlement, scientists at the Metals Research Laboratories of Union Carbide Metals Company, Division of Union Carbide Corporation, have recently discovered. The platinum metal is affixed to the tantalum article, not used as an alloying element in the melting stage. Sputtering, spot welding, or mechanical attachment are among the effective ways of creating the galvanic couple.

A continuous coating is not required according to experiments conducted by Claude R. Bishop and Milton Stern over the past three years. They found that tantalum in contact with platinum in an area ratio of up to 10,000 tantalum to 1 platinum is immune to embrittlement for more than 1,000 hours in concentrated hydrochloric acid at 374 deg. F. Ordinarily, tantalum is embrittled in a few hours in this environment.

In addition, the scientists learned, the corrosion rate of tantalum is not increased by the contact; indeed, in some cases, it decreases. Corrosion rate of platinum, moreover, is reduced to a negligible value by contact with tantalum.

Bishop and Stern also showed that purity, history, source and heat treatment have no apparent influence on

the susceptibility of tantalum to hydrogen embrittlement in aggressive reducing acid media.

The scientists described experiments in which tantalum was successfully protected from embrittlement in highly corrosive environments at different temperatures, or under conditions of cathodic charging. The technique is simple, effective, and should find application by expanding the range of environments which can be served by tantalum, they noted.

Their research is expected to be of great significance in the chemical industry, where there are increasing demands for higher operating temperatures. Bishop and Stern's findings will, it is anticipated, result in the use of more tantalum under corrosive conditions where embrittlement is likely to occur.

Liverwort May Upset Theories

➤ THE STONE remains of a little liverwort, one of the world's most common plants, may upset scientists' theories about how long life has existed on earth. Discovered in the Catskill Mountains by graduate student Francis M. Hueber working under Prof. Harlan P. Banks of the New York State College of Agriculture, Ithaca, N. Y., the fossil was found to date back 330,000,000 years to the Age of the Fishes.

The discoverers believe that since the plant must have been evolving for millions of years before it reached the development shown in the fossil, liverworts may have existed as far back as the Cambrian Age.

This would mean that land plants and perhaps life itself have a longer history on earth than scientists have thought.

Radioactive Gas Detects Heart Holes

➤ CARDIAC SHUNTS — the dangerous mixing of oxygen-poor blood and oxygenated blood through holes in the partition between the left and right sides of the heart — have been successfully detected and located with a radioactive gas, krypton-85.

Three scientists at the National Heart Institute have used the technique on 48 patients.

To detect left-to-right shunts, a small tube is used to inject krypton-85 into the left heart. If there is leakage, the gas crosses directly to the right heart and is pumped directly to the lungs. Thus, a high concentration of the gas in exhaled air will reveal the shunt. The radiation of the expired air can be monitored by a count-rate meter.

The gas is injected into the right heart to detect right-to-left shunts. If there are none, the gas would be pumped to the lungs and expired.

If there are shunts, the gas leaking into the left heart is pumped into the arteries, where arterial blood samples will reveal its presence.

The studies were made by Drs. R. T. L. Long, Eugene Braunwald and A. G. Morrow.

Chemistry Comments

➤ Seven major U. S. cities approved $175,000,000 for water pollution control work during the last election.

➤ The Great Lakes contain the world's largest supply of fresh water.

➤ An automatic technique for determining tiny traces of sulfur dioxide impurities has been perfected to combat air pollution.

➤ A radiometric device for detecting icebergs, now being used by the U. S. Coast Guard, has made the North Atlantic shipping routes safer to travel.

➤ A new appetite suppressing drug, benzphetamine, helps the average over-weight person lose more than a pound a week with no restrictions in diet and a minimum of side effects is now under clinical study.

➤ The first synthesis of a chemical, prodigiosin, may soon control fungus diseases for which no cure now exists.

➤ Some 600,000 boys and girls — many of our future scientists — in our secondary schools take part in school science exhibits each year.

➤ A combination of meclizine and nicotinic acid, a drug usually prescribed for vertigo, is valuable in treating and preventing different kinds of vascular headaches and other discomforts.

➤ Some 400 effective new drugs have been discovered and made available to physicians and their patients over the past ten years in the U. S.

➤ Aspirin, long regarded as a safe and effective remedy for a variety of ailments, is also responsible for more cases of accidental poisoning than any other drug.

➤ "Microcracked chromium," a term applied to a chromium plate with a microscopic system of criss-crossing cracks, promises better protection against corrosion for electroplated parts.

➤ Arsenical ore is a raw material used for the production of nickel.

➤ Some 200 types of dextrin, a carbohydrate used in inks and adhesives, are now made from corn.

➤ In 1959, a total of $197,000,000 was spent on research and development in the prescription drug industry.

➤ Hypoglycemia is an extremly serious disease, characterized by a drastic drop in blood sugar, and it produces such symptoms as convulsions, coma and incoherence.

➤ The automotive industry in the U. S. will use nearly a billion pounds of aluminum a year by 1965.

➤ When the sun's hydrogen is used up, in perhaps five billion years, the solar system will probably be destroyed by a "nova" explosion in the sun.

➤ Beryllium finds many uses in hypersonic aircraft, reactors, missiles, and airborne instrumentation because of its lightness and unusual physical, mechanical and nuclear properties.

➤ The Royal Society of London, this year celebrating its 300th anniversary, is the oldest society of its kind in the world.

➤ Iron ore mined in the United States averages 50% iron and it therefore takes two tons of ore to make one ton of pig iron.

➤ As an alloy with copper, beryllium results in the highest strength copper-based alloy.

➤ Copper is the oldest commercial metal and one of the most significant in the world's economy.

➤ The corrosion of iron is estimated to waste from six billion to seven billion dollars yearly in the U. S.

➤ Vanilla is Madagascar's most valuable export to the U. S., which takes about 90% of the total vanilla exports.

➤ The term "terra cotta" comes from the Italian and means "fired earth."

➤ World capacity for the production of synthetic rubber is now greater than the production capacity for natural rubber.

➤ Several antioxidants are very useful for preventing yellow fat or steatitis, which is a costly disease in mink that are fed fish-cannery wastes.

➤ Fall-applied nitrogen is only about 57% as effective as spring-applied nitrogen for corn in humid areas.

➤ A garden should have about two quarts of water per square foot weekly, while each vegetable should have about one inch of water every week.

➤ Most vegetables are 90% or more water.

➤ Domestic consumption of cotton in textile mills should exceed 9,000,000 bales in 1960.

➤ The bladder of the Portuguese man-of-war contains relatively large volumes of oxygen, nitrogen and carbon monoxide.

➤ Aluminum cars of 1980 may be powered by small fuel cells, fueled by highly efficient petroleum derivatives, inexpensive chemicals or both.

➤ By 1975, industry will use an average of 90 billion gallons of water daily.

➤ In 1850, wood supplied 90% of the nation's fuel needs, but has been replaced by coal, oil and natural gas in the last century.

➤ Adrenalin was first used in 1901, insulin in 1924.

➤ The chemical industry is estimated to have spent more than $600,000,000 in research and development in 1959.

➤ Iodine deficiency is now accepted as the chief cause of endemic goiter throughout the world.

➤ Free Europe is expected to nearly triple its synthetic rubber capacity in the next two years.

➤ In 1948, 86% of the household cleaners sold were soap or soap-based; now the synthetic detergents, both liquid and powders, account for 78% of the household cleaners sold in the U. S.

➤ Blood can now be stored for 30 days between collection and transfusion using a new anticoagulant called Citrate-Phosphate-Dextrose or CPD for short.